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ENVIRONMENTAL CONCERNS ABOUT
THE BROW QUARRY LANDFILL NEAR
GREENSVILLE, ONTARIO

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ENVIRONMENTAL CONCERNS ABOUT THE BROW QUARRY LANDFILL
NEAR GREENSVILLE, ONTARIO

Prepared for:

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INTRODUCTION

The Brow Quarry Landfill is owned and operated by Steetley Industries Ltd. The site is located atop the Niagara Escarpment on parts of lots 13, 14, and 15, Concession 1 in Flamborough Township, Ontario.

The landfill has been in operation for about 10 years, and has been operating since May, 1980 under a provisional Certificate of Approval (No. A-130511) issued by the Ministry of the Environment (MOE). The site is licensed only for disposal of 100% non-hazardous industrial wastes.

This report outlines environmental concerns about possible impacts of the landfill on the environment. The landfill has been the topic of increasingly intense local debate because of persistent but (in the past) unsubstantiated allegations of dumping of hazardous wastes at the site. There are also concerns that the monitoring of the the site by the Hamilton office of the MOE has been inadequate to date.

The report is based on a critical review of information available on the site and the surrounding area, including consultants' reports and documents obtained from the Hamilton office of the MOE. Further information about the site was obtained from conversations with local residents, members of Greensville Against Serious Pollution or GASP (a local citizens group), MOE officers, and Hamilton-Wentworth Region employees.

INTRODUCTION

The New County Council is now and again by the
Industrial Ltd. The site is located along the Niagara Highway
on lots 11, 14, and 15, Commission 1 in Township
Township, Ontario.

The landfill has been in operation for about 10 years, and
has been operating since May, 1988 under a provincial Certificate
of Approval (No. A-11821) issued by the Ministry of the
Environment (MOM). The site is licensed only for disposal of non-
hazardous industrial wastes.

This report outlines environmental concerns about possible
impacts of the landfill on the environment. The landfill has been
the topic of increasingly intense local debate because of
persistent but (in the past) unsubstantiated allegations of
leakage of hazardous wastes to the site. There are also concerns
that the location of the site by the Hamilton office of the
MOM has been inadequate to date.

The report is based on a critical review of information
available on the site and the surrounding area, including
consultants' reports and documents obtained from the Hamilton
office of the MOM. Further information about the site was
obtained from conversations with local residents, members of
Greenpeace Against Toxics Coalition or GATC (a local citizens
group), MOM officers, and Hamilton-Wentworth region engineers.

SITE HYDROGEOLOGY

The Brow Quarry Landfill is located on a southward facing promontory of the Niagara Escarpment, bounded by Sydenham Creek to the east and Spencer Creek to the west (Golder Associates, 1984). The old quarry was excavated to a maximum depth of more than 25 m below the local bedrock surface. The bedrock which makes up the walls of the landfill is a jointed and fractured dolostone, while the base of the quarry generally follows the contact to an underlying unit of interbedded shales and dolostones.

Golder Associates testing showed that the dolostone unit making up the walls of the landfill and the interbedded shale unit underlying the site have a relatively high hydraulic conductivity of about 10^{-3} cm/s (about 300 m/year). Hydraulic conductivity is a parameter used to determine how quickly water flows through a geologic formation (Freeze and Cherry, 1979). In their report, Golder Associates (1984) assume that the interbedded shale unit has a very low hydraulic conductivity of 10^{-6} to 10^{-8} m/s.

In the south end of the old quarry, a deeper lift was excavated to a maximum depth of about 5 m below the general quarry base. The interbedded shale unit has a thickness of only about 6 meters, so there is a good possibility that in this area there is a direct hydraulic contact to the underlying layer of dolostone.

The fractured dolostone unit in which the quarry is located is a good quality aquifer, used by farms and residences north of

The new quarry (Lindsey) is located on a southward facing slope of the Lindsey Formation, bounded by Highway 100 to the east and Highway 100 to the west (Lindsey, 1964). The old quarry was expanded to a maximum depth of more than 100 feet below the local bedrock surface. The bedrock which occurs up the valley of the Lindsey is a jointed and fractured dolomite, while the base of the quarry generally follows the contact to an underlying unit of interbedded shale and dolomite.

Geological studies have shown that the Lindsey unit contains up the valley of the Lindsey and the interbedded shale and dolomite. The shale have a relatively high hydraulic conductivity of about 10⁻⁴ cm/sec (about 100 m/sec). Hydraulic conductivity is a parameter used to determine how quickly water flows through a porous medium (Frost and Cherry, 1972). In this report, Geology Associates (1964) assume that the interbedded shale and dolomite have a very low hydraulic conductivity of 10⁻⁷ to 10⁻⁸ cm/sec.

In the south end of the old quarry, a deeper pit was excavated to a maximum depth of about 200 feet below the general quarry base. The interbedded shale unit has a thickness of only about 2 feet, so there is a good possibility that in this area there is a direct hydraulic contact to the underlying layer of dolomite.

The fractured dolomite unit in which the quarry is located is a good quality aggregate, used by local and regional areas of

the escarpment for water supplies (Terraqua, 1987). Groundwater flow in the bedrock is to the south, away from residents' wells and toward the Niagara Escarpment. Groundwater discharge occurs from springs and seeps along the the escarpment face above Dundas.

When the landfill first went into operation, wastes were simply dumped onto the bedrock floor of the landfill. Wilson Associates (1976) reported (prior to the use of the quarry as a landfill) that some seepage into the quarry occurred from fractures in its rock walls. Later in the life of the landfill, leachate likely drained into the groundwater flow system via these same fractures. In their investigation of the landfill, Golder Associates (1984) reported witnessing landfill drainage through the quarry bottom, and reported that some runoff from the south part of landfill occasionally flowed over the escarpment edge. Landfill leachate drained from the site through the base and walls of the quarry until late 1986, when a leachate collection system was installed. The fraction of the total landfill leachate now being intercepted by the collection system is unknown.

The permeable nature of the bedrock makes the quarry an unsuitable location for a landfill. The original decision to allow landfiling to take place at the site without attempting to contain or collect leachate would not be made today. Any contaminants escaping the landfill can be expected to flow quickly toward the escarpment via the groundwater flow system in the fractured dolostone bedrock.

The assignment for water quality (Trenton, 1957). Groundwater flow in the bedrock is to the south, away from the bedrock, and toward the Niagara escarpment. Groundwater discharge occurs from springs and seeps along the escarpment from the bedrock.

When the landfills first went into operation, water was simply dumped onto the surface from the landfills. Water associated with the landfills (prior to the use of the quarry as a landfill) that some seepage into the quarry occurred from fractures in the rock walls. Located in the fill of the landfills, discharge likely drained into the groundwater flow system via these same fractures. In their investigation of the landfills, Golder Associates (1985) reported witnessing landfill leachate through the quarry bottom, and reported that some leachate from the south end of landfill occasionally flowed over the escarpment edge. Landfill leachate drained from the site through the base and walls of the quarry until late 1985, when a leachate collection system was installed. The fraction of the total landfill leachate now being intercepted by the collection system is unknown.

The possible nature of the bedrock water for quarry as a suitable location for a landfill. The original decision to allow landfilling to take place at the site without extending to contain or collect leachate would not be made today. Any groundwater escaping the landfill can be expected to flow generally toward the escarpment via the groundwater flow system in the fractured bedrock bedrock.

TYPES OF WASTES ACCEPTED AT THE LANDFILL

The site is licensed to receive only 100% non-hazardous industrial wastes. Most wastes come from Hamilton-area steel mills and include foundry slag, flue dust, and blast furnace bag house dust. The site also receives large volumes of shredder wastes, foundry sand, wood and construction waste, and tires. Bag house dust from the Steetley kilns is also disposed of in the landfill.

TESTING OF INCOMING WASTES

Tests are carried out by the Steetley laboratories on samples of the wastes submitted prior to dumping. Visual inspection of trucks entering the landfill often takes place, and samples may be taken from trucks for further testing at that time. The samples are tested to determine whether they are "non-hazardous" according to MOE standards and acceptable for dumping.

The MOE standards cover inorganic chemicals including heavy metals, and also cover a number of pesticides and herbicides. The standards make no mention of hazardous industrial organic chemicals except for poly-chlorinated biphenyls (PCB's). This is a serious omission since, of all chemicals found in landfills, the hazardous organic chemicals are now recognized to present the greatest threat to groundwater quality (Cherry et al, 1987).

In Aug. 1988, Steetley's analyses of some shipments of wastes dumped at the landfill showed that these contained levels of PCB's

TESTING OF WASTES ACCEPTED AT THE LANDFILL

The site is licensed to receive only 100% non-hazardous industrial wastes. Wastes accepted from Hamilton-area mills and include foundry sludge, lime sludge, and blast furnace bag house dust. The site also receives large volumes of untreated waste, foundry sand, wood and construction waste, and litter. Bag house dust from the Tennessee Alkali is also disposed at the landfill.

TESTING OF TREATING WASTES

Tests are carried out by the facility inspectors on samples of the wastes submitted prior to dumping. Visual inspection of trucks entering the landfill often takes place, and samples may be taken from trucks for further testing at that time. The samples are tested to determine whether they are "non-hazardous" according to RCRA standards and acceptable for dumping.

The RCRA standards cover inorganic chemicals including heavy metals, and also cover a number of pesticides and herbicides. The standards also include a number of hazardous inorganic organic chemicals except for poly-chlorinated biphenyls (PCBs). This is a serious omission since, of all chemicals found in landfills, PCBs are the most persistent organic chemicals and are recognized to present the greatest threat to groundwater quality (Cherry et al., 1987).

In Aug. 1988, Kentucky's analysis of some shipments of wastes dumped at the landfill showed that these contained levels of PCBs

considered to be hazardous. GASP has been unable to determine whether the wastes also contained other hazardous organic chemicals, or whether these are the only shipments of wastes containing hazardous chemicals that have entered the site.

At an Oct. 13th, 1988 meeting with GASP and the MOE, Steetley officials claimed that their inspection system worked and had caught the PCB-bearing waste. They would not, however, disclose whether the incoming waste had been tested for other hazardous organic chemicals in the past.

WATER QUALITY MONITORING PROGRAM

Groundwater and surface water quality in the vicinity of the landfill have been monitored on at least a semi-annual basis since 1978, to determine the impact (if any) of the landfill on the environment. The water sampling is usually carried out by Steetley personnel, and samples are analysed by the Steetley Industries Research and Development Laboratory. The MOE does not sample or analyse water samples itself, and does not perform tests of its own to check the results of the Steetley monitoring program.

The groundwater and surface water samples are analysed for pH, conductivity, hardness, phenols, major ions, and some metals. No testing has been carried out to determine whether hazardous organic chemicals are contaminating groundwater or surface water in the area surrounding the site, even though such testing is now commonly done at Ontario landfills.

considered to be hazardous. OSHA has been unable to determine whether the wastes also contained other hazardous organic chemicals, or whether these are the only chemicals of waste-containing hazardous chemicals that have entered the site.

At an OGC, 11/16/1988 meeting with OGC and the WUE, Stanley, officials claimed that their inspection system worked and had caught the PCB-leaking waste. They would not, however, discuss whether the leaking waste had been tested for other hazardous organic chemicals in the past.

WATER QUALITY MONITORING PROGRAM

Groundwater and surface water quality in the vicinity of the landfill have been monitored on at least a semi-annual basis since 1979, to determine the degree (if any) of the landfill on the environment. The water sampling is usually carried out by Stanley personnel, and samples are analyzed by the Stanley Industrial Research and Development Laboratory. The WUE does not sample or analyze water samples itself, and does not perform tests of its own to check the results of the Stanley monitoring program.

The groundwater and surface water samples are analyzed for pH, conductivity, hardness, phenols, major ions, and some metals. No testing has been carried out to determine whether hazardous organic chemicals are contaminating groundwater or surface water in the area surrounding the site, even though such testing is now commonly done at Ontario landfills.

LEACHATE COMPOSITION

Leachate obtained from Standpipe No. 2 in the landfill is tested at regular intervals for the same parameters as surface water. The results of this testing show that the leachate is a very unpleasant liquid. Golder Associates (1984) report that the leachate is yellowish in colour and gives off very strong smelling fumes of an unrecognizable smell. The leachate is high in total dissolved solids (TDS), with values ranging from about 4000 to 13000 mg/L.

The elevated levels of biochemical oxygen demand or BOD (500 to 2000 mg/L), chemical oxygen demand or COD (750 to 4000 mg/L), total organic carbon or TOC (450 to 1350 mg/L), and phenols (1.4 to 10.6 mg/L) indicate that there are very high concentrations of organic constituents in the leachate. An obvious question then is whether some of these organic constituents might be hazardous.

In the summer of 1988, GASP inquired whether hazardous organic chemicals might be present in the Brow Quarry landfill and criticized the lack of site monitoring by the MOE (Steetley personnel monitor the site). MOE officials indicated their confidence in Steetley and expressed little concern about the possibility of hazardous organic chemicals being present in the landfill leachate. This is because they felt that these chemicals were not contained in the wastes allowed into the landfill, and were therefore unlikely to be found within the landfill.

Residue Analysis

Residue obtained from Sample No. 1 in the 1955-56 season tested at regular intervals for the same parameters as residue No. 1. The results of this testing show that the residue is a very unpleasant liquid. Other Analyses (1955) report that the residue is relatively in color and gives off very strong smelling fumes of an unrecognizable smell. The residue is high in total dissolved solids (TDS) with values ranging from about 1000 to 1500 mg/L.

The elevated levels of chemical oxygen demand or COD (200 to 400 mg/L), chemical oxygen demand or COO (150 to 400 mg/L), total organic carbon or TOC (150 to 450 mg/L), and nitrate (1.4 to 10.5 mg/L) indicate that there are very high concentrations of organic constituents in the residue. An obvious question then is whether some of these organic constituents might be hazardous.

In the summer of 1956, 1958 indicated whether hazardous organic chemicals might be present in the New County landfill and criticized the lack of site monitoring by the NCE. Personnel monitor the site. NCE officials indicated their confidence in testing and expressed little concern about the possibility of hazardous organic chemicals being present in the landfill residue. This is because they felt that these chemicals were not contained in the waste allowed into the landfill and were therefore unlikely to be found within the landfill.

However, in August 1988, a search of MOE files indicated that the landfill leachate had been sampled on October 22, 1984 by Golder Associates for the presence of hazardous organic chemicals. Then, in October 1988, the results of 1986 and 1987 leachate tests for hazardous organic chemicals became available from the MOE.

The results of these tests are somewhat contradictory, but they are a cause for considerable concern. Twenty-one organic chemicals (most of which are hazardous) were detected in one or more tests of the landfill leachate (Table 1). Seventeen of the 21 chemicals are included in the U.S. Environmental Protection Agency (EPA) list of Priority Pollutants (Table 1). These are chemicals which the EPA considers hazardous - some are highly toxic to human or aquatic life, some are thought to be carcinogenic (cancer causing), tetragenic (causing birth defects) or mutagenic (causing mutations).

Two of the organic chemicals are listed by the MOE in the Environmental Protection Act (Reg. 309) as acute hazardous waste chemicals, and 12 others are listed as hazardous waste chemicals (Table 1). Canadian standards have not yet been developed for discharges of these chemicals into the environment. In the absence of such standards and in order to help the public assess the hazards posed by the chemicals in the leachate, their concentrations and the 1987 Canadian drinking water guidelines are listed in Table 1. The 1984 New York State Water Quality Criteria are also included for comparison.

However, in August 1988, a number of new sites indicated that the landfill facilities had been sampled on October 12, 1988 by Golden Associates for the purpose of hazardous waste analysis. Then, in October 1988, the results of 1988 and 1989 landfill tests for hazardous organic chemicals became available from the HNE.

The results of these tests are somewhat contradictory, and they are a cause for considerable concern. Twenty-one organic chemicals (most of which are hazardous) were detected in one or more tests at the landfill (Table 1). Eleven of the chemicals are included in the U.S. Environmental Protection Agency (EPA) list of Priority Pollutants (Table 1). These are chemicals which the

toxic to humans at a carcinogenic (cancer-causing) or mutagenic (causing genetic mutations)

Two of the chemicals are listed by the HNE in the Environmental Protection Act as acute hazardous waste chemicals, and 12 others are listed as hazardous waste chemicals (Table 1). Canadian standards have not yet been developed for

discharge of these chemicals into the environment. In the absence of such standards and in order to help the public assess the hazards posed by the chemicals in the landfill, their concentrations and the 1987 Canadian drinking water guidelines are

listed in Table 1. The 1984 New York State Water Quality Criteria are also included for comparison.

Leachate forms when rainwater seeps through a landfill and dissolves or leaches chemicals from the wastes (Driscoll, 1986). The composition of leachate directly reflects the composition of wastes contained in the landfill. The levels of hazardous organic chemicals in the Brow Quarry landfill leachate are not as high as in leachate from some other Ontario landfills, however the presence of as many as 21 hazardous organic chemicals in the landfill leachate indicates that shipments containing hazardous wastes have been dumped at the landfill in the past.

The concentration of chemicals in the leachate will likely increase as long as the site remains in operation. Leachate concentrations and production will decrease after the site is closed. It is not known how long after closure the landfill will continue to generate leachate, however some landfills from the Roman Empire still produce leachate today (Freeze and Cherry, 1979).

LEACHATE COLLECTION AND TREATMENT

A portion of the leachate from the Brow Quarry landfill has been intercepted by the site's leachate collection system since late 1986, piped down the escarpment via a closed culvert and fed into the Dundas sanitary sewer system. The water from the sewer system is treated at the Dundas sewage treatment plant.

At the Oct. 13th meeting, Steetley officials indicated that the leachate from the landfill's collection system had been tested annually for hazardous organics. They stated that organics were

Leach's theory when compared with the results of
discovery or research conducted from the winter (1955).
The composition of Leach's theory directly reflects the composition of
water contained in the body. The levels of various organic
chemicals in the body (Leach's theory) are not as high as
in Leach's theory. However, the
presence of as many as 21 different organic chemicals in the
Leach's theory indicates that various organic chemicals
water have been found in the body in the past.

The composition of chemicals in the body will likely
increase as long as the body remains in operation. Leach's con-
centrations and production will decrease after the body is closed.
It is not known how long after closure the body will continue
to produce chemicals, however, some Leach's theory from the human body
will produce chemicals (Leach's theory, 1955).

LEACH'S COLLECTION AND TREATMENT

A portion of the Leach's theory from the body (Leach's theory) has
been interpreted by the body's Leach's collection system since
late 1955, along with the treatment via a closed circuit and led
into the body's Leach's theory system. The water from the body
system is treated at the body's Leach's theory system.

At the Oct. 1955 meeting, Stanley officials indicated that
the Leach's theory from the body's collection system had been tested
anomaly for hazardous organisms. They stated that organisms were

found, that Hamilton-Wentworth Region personnel had been informed of the results of this testing, and that these personnel had decided that the sewage treatment plant could handle the wastes. None of the regional personnel responsible for wastewater treatment (including workers at the Dundas Sewage Treatment Plant) contacted by GASP had any knowledge about the possible presence of hazardous organic chemicals in Steetley leachate, and none had been contacted or informed by Steetley officials about this matter.

It is not known whether sewage treatment plants like the one in Dundas can deal with hazardous organic chemicals such as those contained in leachate from the Brow Quarry Landfill (McGinley and Kmet, 1984). The treated effluent from the Dundas sewage treatment plant is not tested for the presence of these chemicals before being discharged to Cootes Paradise. The effects of these chemicals on the health of workers at the plant are not known.

GROUNDWATER CONTAMINATION

The results of the groundwater quality monitoring program, which has been carried out since 1978, indicate that water which has been contaminated by landfill leachate has escaped the site. Water quality parameters useful in determining the extent of groundwater contamination by leachate from the Brow Quarry landfill include chloride and total dissolved solids (TDS).

Levels of these parameters in leachate from the landfill are about 10 to 100 times higher than background levels of these

found, that identified North-South Regional personnel had been informed of the results of this testing, and that these personnel had decided that the sewage treatment plant could handle the wastes from the regional personnel responsible for wastewater treatment (including workers of the North-South Regional Plant) contacted by GAGE had any knowledge about the possible presence of hazardous organic chemicals in treated effluent, and none had been contacted or informed by GAGE's officials about this matter. It is not known whether sewage treatment plants like the one in London can deal with hazardous organic chemicals such as those contained in treated effluent from the Gray-Gundy landfill (McGillivray and Knox, 1981). The treated effluent from the London sewage plant went plant is not tested for the presence of these chemicals before being discharged to local waterways. The extent of these chemicals in the effluent of the plant are not known.

GROUNDWATER CONTAMINATION

The results of the groundwater quality monitoring program, which has been carried out since 1974, indicate that water which has been contaminated by landfill leachate has seeped into the water supply. Water quality parameters tested in determining the extent of groundwater contamination by leachate from the Gray-Gundy landfill include chloride and total dissolved solids (TDS). Levels of these parameters in leachate from the landfill are about 10 to 100 times higher than background levels of these

parameters in groundwater in the fractured dolostone bedrock. Changes over time in levels of chloride in springs and some groundwater monitors are illustrated in figures 1 to 4.

The steadily increasing levels of chloride, TDS, and other parameters observed in some groundwater monitors and springs on the escarpment, indicate a progressively increasing contamination (by leachate) of the area groundwater over the 10-year life of the landfill. This is not surprising since the leachate collection system was not installed until late 1986. The degree of groundwater contamination around the landfill may be positively affected by the newly installed leachate collection system, however none of the information available indicates that this is occurring yet.

SURFACE WATER CONTAMINATION

The Brow Quarry Landfill has had a negative effect on the quality of on-site surface waters over its 10 years lifespan. The ponds located within the site boundary show elevated levels of parameters such as phenols, chloride, and TDS which indicate their contamination by landfill leachate.

The landfill has affected the quality of off-site surface waters as well. Direct flow of surface water across the landfill and over the escarpment during heavy rainfall events and during spring snowmelt was reported by Golder Associates (1984). Steetley officials indicated that this problem has not recurred in recent years.

relationship is demonstrated in the attached diagram.

Changes over time in levels of chloride in spring and summer

groundwater are illustrated in Figures 1 to 4.

The steadily increasing levels of chloride, TDS, and water
parameters observed in some groundwater monitoring and spring
the watershed, indicate a progressively increasing contribution
(by recharge) of the area groundwater over the 10 year life of the
landfill. This is not surprising since the landfill collection
system was not installed until late 1984. The degree of ground-
water contamination around the landfill may be positively affected
by the newly installed landfill collection system, however none of
the information available indicates that this is occurring yet.

SUBSISTING WATER CONTAMINATION

The Bow Valley Landfill has had a negative effect on the
quality of surface water where over the 10 year lifespan. The
ponds located within the site boundary show elevated levels of
parameters such as phenols, chlorides, and TDS which indicate their
contamination by landfill leachate.

The landfill has affected the quality of off-site surface
water as well. Direct flow of surface water across the landfill
and over the surrounding during heavy rainfall events and during
spring snowmelt was reported by Golden Associates (1984).

Recently officials indicated that this problem has not occurred in
recent years.

One of the two monitored springs which discharge on the escarpment face shows a steady deterioration in water quality over time. Property owners in the Town of Dundas have informed GASP about the occasional occurrence of coloured and noxious smelling liquids seeping down the escarpment. Since the MOE has not received any formal complaints there has been no investigation by the MOE into the relationship (if any) between the landfill and these occurrences, or into the potential for health hazards to Dundas residents. The springs and backyards have never been tested for the presence of hazardous organic chemicals, and the degree of their contamination and the effects (if any) on plant, animal, and human life are unknown.

Some contaminated groundwater can be expected to flow into Spencer Creek and Sydenham Creek. Flow volumes in these creeks are normally high enough that the concentrations and impacts of contaminants from groundwater and escarpment springs discharging into the creeks will be small and difficult to measure.

The ability of the Dundas Sewage Treatment Plant to treat hazardous organic chemicals in the landfill leachate is unknown. Hamilton-Wentworth Region personnel indicated that the effluent from the plant should have much lower hazardous chemical concentrations than the incoming water. Effluent from the plant, which is currently not tested for the presence of these chemicals, flows into Cootes Paradise. The impact of the effluent on aquatic life in Cootes Paradise is unknown.

One of the two monitored springs which discharge on the
reservoir bank shows a steady deterioration in water quality over
time. Frequent samples in the Town of Ontario have indicated that
about the reservoir, occurrence of coliforms and various bacteria
frequently sampled from the reservoir. Since the HOE has not
received any formal complaints there has been no investigation to
see how the water quality (i.e. any) between the hospital and
these outflows, or into the reservoir for health reasons for
human residents. The spring and reservoir have never been
tested for the presence of bacteria, organic chemicals, and the
degree of their contamination and the ability to supply water.
Animal, and human, life are unknown.

Some contaminated groundwater can be expected to flow into
Spring Creek and Hydroelectric Creek. These volumes in these creeks
are normally high enough that the concentrations and levels of
contaminants from themselves and surrounding spring discharge
into the creek will be small and difficult to measure.

The ability of the Ontario Design Treatment Plant to treat
bacteria, organic chemicals in the hospital discharge is unknown.
Health-Canada's design personnel indicated that the effluent
from the plant should have much lower bacterial counts.
Concentrations from the treated water. Effluent from the plant,
which is currently not tested for the presence of these chemicals,
flows into Ontario Reservoir. The impact of the effluent on
aquatic life in Ontario Reservoir is unknown.

IMPLICATIONS

- 1) Leachate from the landfill contains small but significant concentrations of chemicals classified as hazardous by regulatory agencies in Canada and the U.S.A. The presence of these chemicals in the landfill leachate indicates that wastes containing hazardous organic chemicals have been dumped at the Brow Quarry Landfill in the past, in violation of the site's Certificate of Approval.
- 2) The inspection system used to check loads of wastes arriving for disposal can not reasonably be expected to be foolproof in detecting the small amounts of hazardous organic chemical wastes sufficient to cause major leachate contamination problems.
- 3) The water quality monitoring program indicates that groundwaters beneath and downflow of the landfill, including springs on the escarpment face, have been contaminated to some degree by leachate.
- 4) Testing has not yet been carried out to determine whether hazardous organic chemicals are present in the groundwater or springs downflow of the site. Hazardous organic chemicals may eventually reach all areas where groundwater contamination is currently indicated by parameters such as chloride and TDS.
- 5) The Dundas sewage treatment plant may not be able to deal with the landfill leachate, in which case hazardous organic chemicals will be discharged from the plant into Cootes Paradise.

RECOMMENDATIONS

- 1) The frequency of inspections of loads of wastes entering the Brow Quarry Landfill should be increased by Steetley, as should the number of hazardous organic chemicals being tested for.
- 2) Prosecution of companies caught disposing of hazardous wastes in the landfill should be carried out to the fullest extent possible by Steetley Industries Ltd. and by the MOE.
- 3) A comprehensive attempt should be made to determine the lateral and vertical extent of the plume of contaminated groundwater beneath and downflow of the landfill, as defined by several conservative indicator parameters such as chloride.
- 4) Three separate tests covering the full suite of EPA Priority Pollutants should be carried out immediately to try to determine which organic chemicals are now present in the landfill leachate.
- 5) If the presence of hazardous organic chemicals in the landfill leachate (indicated by 1984, 1986, and 1987 test results) is confirmed, then the leachate and all groundwater monitors, springs and surface waters which may be contaminated by landfill leachate should be tested on a bi-monthly basis for the presence of the full suite of Priority Pollutants.

After 6 months, once an organic contaminant profile has been established for off-site locations, the number of chemicals being tested for can be reduced to include only those chemicals which can reasonably be expected to have reached those locations. An

RECOMMENDATIONS

- 1) The frequency of inspection of loads of wastes entering the New Guinea landfill should be increased by threefold, as should the number of hazardous organic chemicals tested for.
- 2) Inspection of companies cannot eliminate all hazardous wastes in the landfill should be carried out in the following manner: General by X-ray fluorescence and by the HPL.
- 3) A comprehensive strategy should be made to determine the lateral and vertical extent of the spread of contaminants groundwater beneath and downwind of the landfill, as defined by several conservative indicator parameters such as chloride.
- 4) Three separate tests covering the full suite of EPA priority pollutants should be carried out immediately to try to determine which organic chemicals are now present in the landfill leachate.
- 5) If the presence of hazardous organic chemicals in the landfill leachate (indicated by 1994, 1995, and 1997 test results) is confirmed, then the leachate and all groundwater monitoring points and surface waters which may be contaminated by landfill leachate should be tested on a bi-monthly basis for the presence of the full suite of priority pollutants.
- 6) After 6 months, once an organic contaminant profile has been established for off-site locations, the number of chemicals being tested for can be reduced to include only those chemicals which are reasonably expected to have reached those locations.

annual test for the full suite of EPA Pollutants should be carried out to confirm the appropriateness of the contaminant profile.

6) If Steetley Industries personnel continue to do the sampling and chemical analyses for the landfill leachate, springs and groundwater monitors, then random testing should be carried out at regular intervals by the MOE to confirm the data thus obtained.

7) Future cases of noxious liquids flowing from the escarpment face into the backyards of homeowners in Dundas should be reported to the MOE, and investigated to determine the source and composition of the liquids and to determine the potential impacts on the health of local residents.

8) A study should be carried out by the MOE to determine whether the Dundas sewage treatment plant is capable of dealing with the Brow Quarry Landfill leachate. The study should include monitoring of the effluent from the plant for the hazardous organic chemicals found in the landfill leachate.

9) Residents of the Dundas and Flamborough area and workers at the Dundas Sewage Treatment Plant should be fully informed by the MOE about the results of all investigations into the Brow Quarry Landfill. Information should also be made available about the properties and potential hazards to health of all organic chemicals found in the landfill leachate and/or groundwater monitors.

annual test for the full range of the pollutants should be carried out to confirm the appropriateness of the treatment system.

6) If possible, industrial effluents coming to the receiving and chemical analysis for the landfill leachate, sewage and groundwater monitors. Then random testing should be carried out at regular intervals by the MOC to confirm the data then obtained. Future cases of noxious liquids flowing from the treatment tank into the leachate or groundwater in future should be reported to the MOC, and investigated to determine the source and composition of the liquids and its relevance to the potential impacts on the health of local residents.

7) A study should be carried out by the MOC to determine whether the landfill leachate treatment plant is capable of dealing with the growing quantity of leachate. The study should include monitoring of the effluent from the plant for the presence of organic chemicals found in the landfill leachate.

8) Residents of the ponds and Kluang area and workers at the ponds sewage treatment plant should be fully informed by the MOC about the results of all investigations into the growing quantity of leachate. Information should also be made available about the detection and potential hazards to health of all organic chemicals found in the landfill leachate and/or groundwater monitors.

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TABLE 1: ORGANIC CONTAMINANTS IN THE BROW QUARRY LANDFILL

Contaminant Type	Standpipe 2 Concentration (ppb)			Standpipe 3 Concentration (ppb) 1984 only	Canadian Guidelines (ppb)	New York State Guidelines (ppb)	Ontario Classification	EPA Priority Pollutant
	1984	1986	1987					
acenaphthylene	1	-	-	1.8	=	=		yes
anthracene	3	-	1	7.5	=	50		yes
benzene	-	-	27*	-	5 (MAC)	0.0	HVC I ON 2031	yes
bis(2-BH)phthalate	?	4.1	18*	?	=	4200	HVC I ON 2036	yes
chloroform	?	-	16*	?	350 (MAC)	100	HVC I ON 2104	yes
1,1 dichloroethane	-	-	-	10	=	50	HVC I ON 2153	yes
dimethylbenzenes (xylenes)	50	N.T.	N.T.	120	300 (AO)	50	HVC I ON 2045	
di-n-butylphthalate	?	-	10*	?	=	770		
di-n-octylphthalate	?	5.3	-	?	=	50	HVC I ON 2040	yes
ethylbenzene	119	5.4	14	208	2.4 (AO)	50		yes
fluoranthene	1.1	-	7.8	-	=	0.2	HVC I ON 2066	yes
fluorene	3.4	-	-	2.8	=	50	AHVC I ON 1066	yes
methylene chloride	-	-	2300	-	=	10	HVC I ON 2131	yes
naphthalene	15.6	-	-	25.1	=	10	HVC I ON 2207	yes
phenol	400	-	-	325	u.r.	1.0	HVC I ON 2049	yes
phenanthrene	-	-	29	-	=	50		yes
pyrene	8.7	-	4.8	16.1	=	0.2		yes
tetrachloroethylene	-	1.7	-	-	u.r.	2	HVC I ON 2166	
toluene	28	1.6	27	66	24 (AO)	50	HVC I ON 2050	yes
toxaphene	1.0	?	?	-	u.r.	0.0	AHVC I ON 1032	yes
trimethylbenzene	100	N.T.	N.T.	150	=	=		

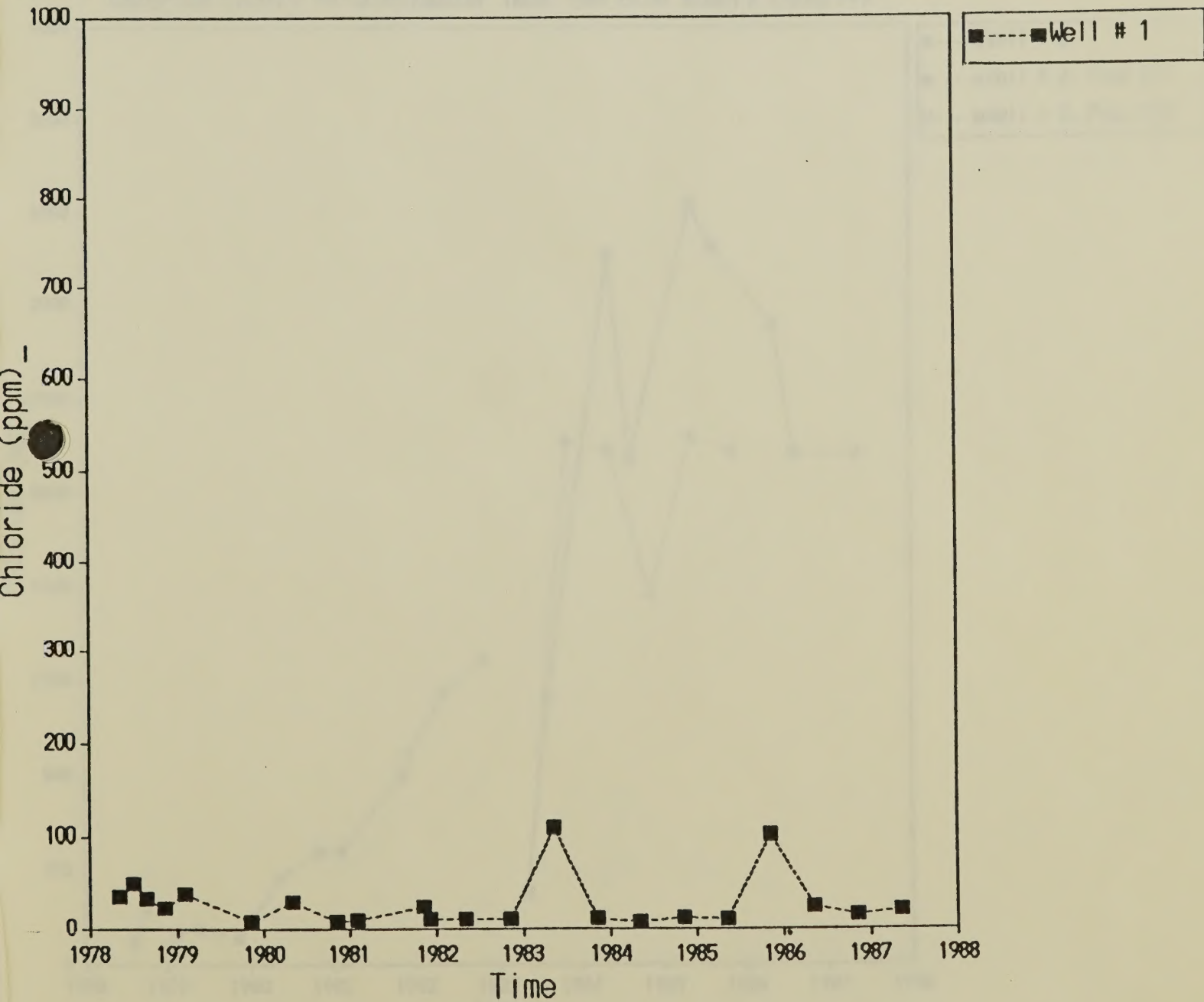
The key to the symbols used in Table 1 is on the following page:

KEY TO SYMBOLS USED IN TABLE:

-	contaminant not detected in sample in this sampling round
#	anthracene and phenanthrene totals merged in this sampling round
N.T.	no test carried out for this chemical in this sampling round
?	chemical not found, possibly because of higher detection limits in this sampling round
*	possible interference, concentrations may be too high
=	no drinking water limit established for this chemical
MAC	maximum acceptable concentration
AO	aesthetic objective
u.r.	under review, guideline to be established
ANVC	acute hazardous waste chemical
HVC	hazardous waste chemical



Chloride Levels in Groundwater near the Brow Quarry Landfill

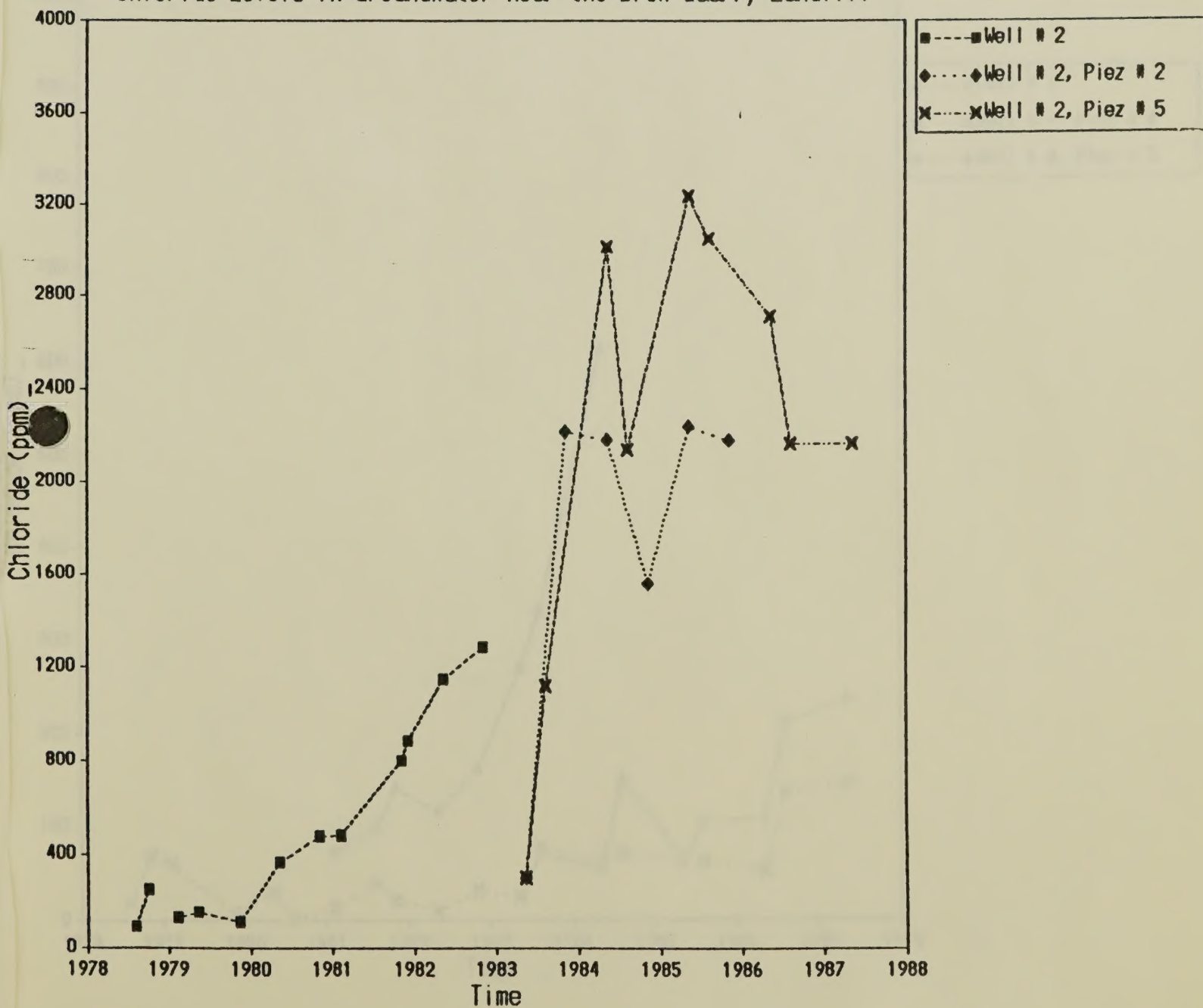


Hydro levels in Greatwater near the Brown County Landfill

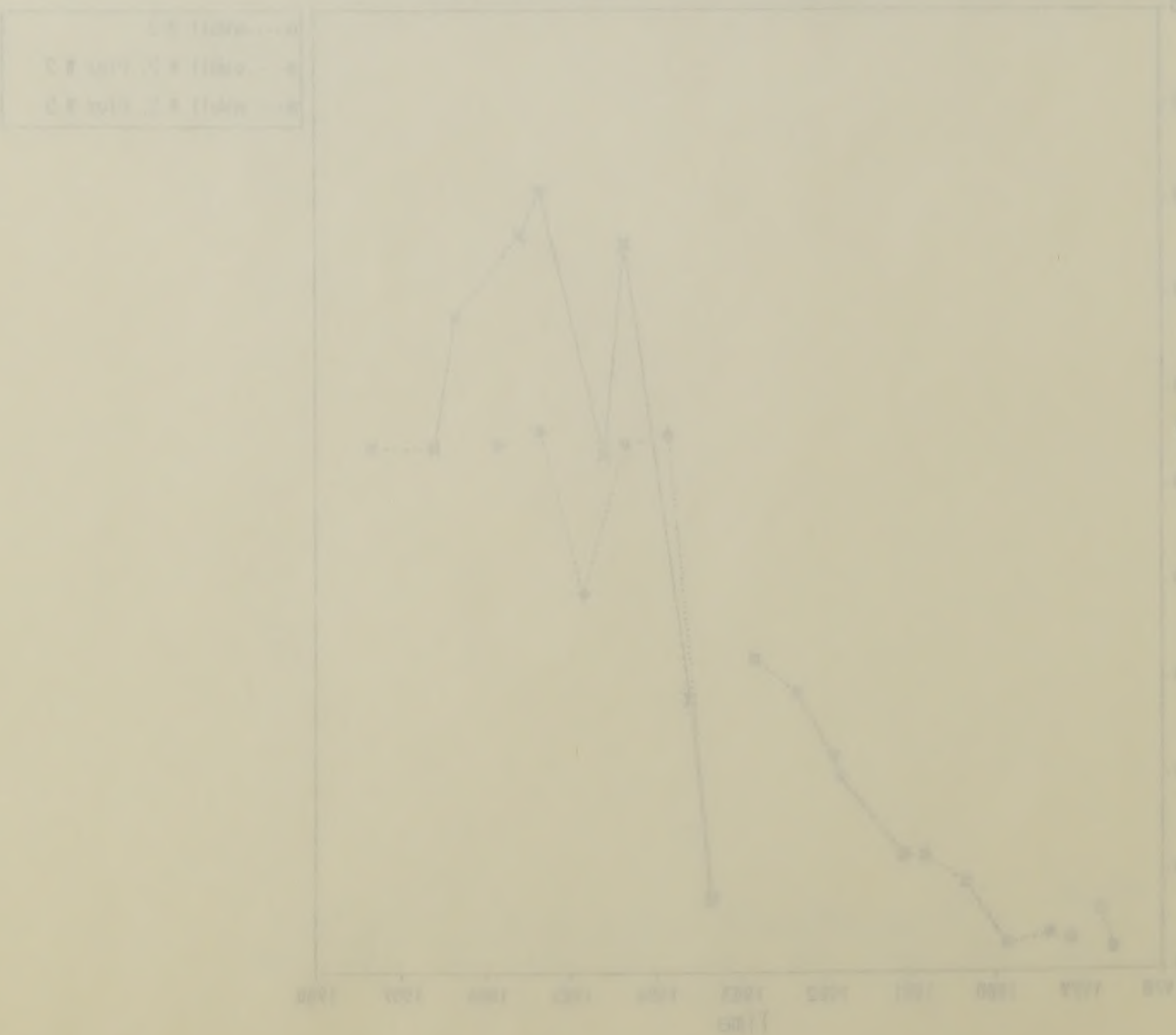
Figure 1



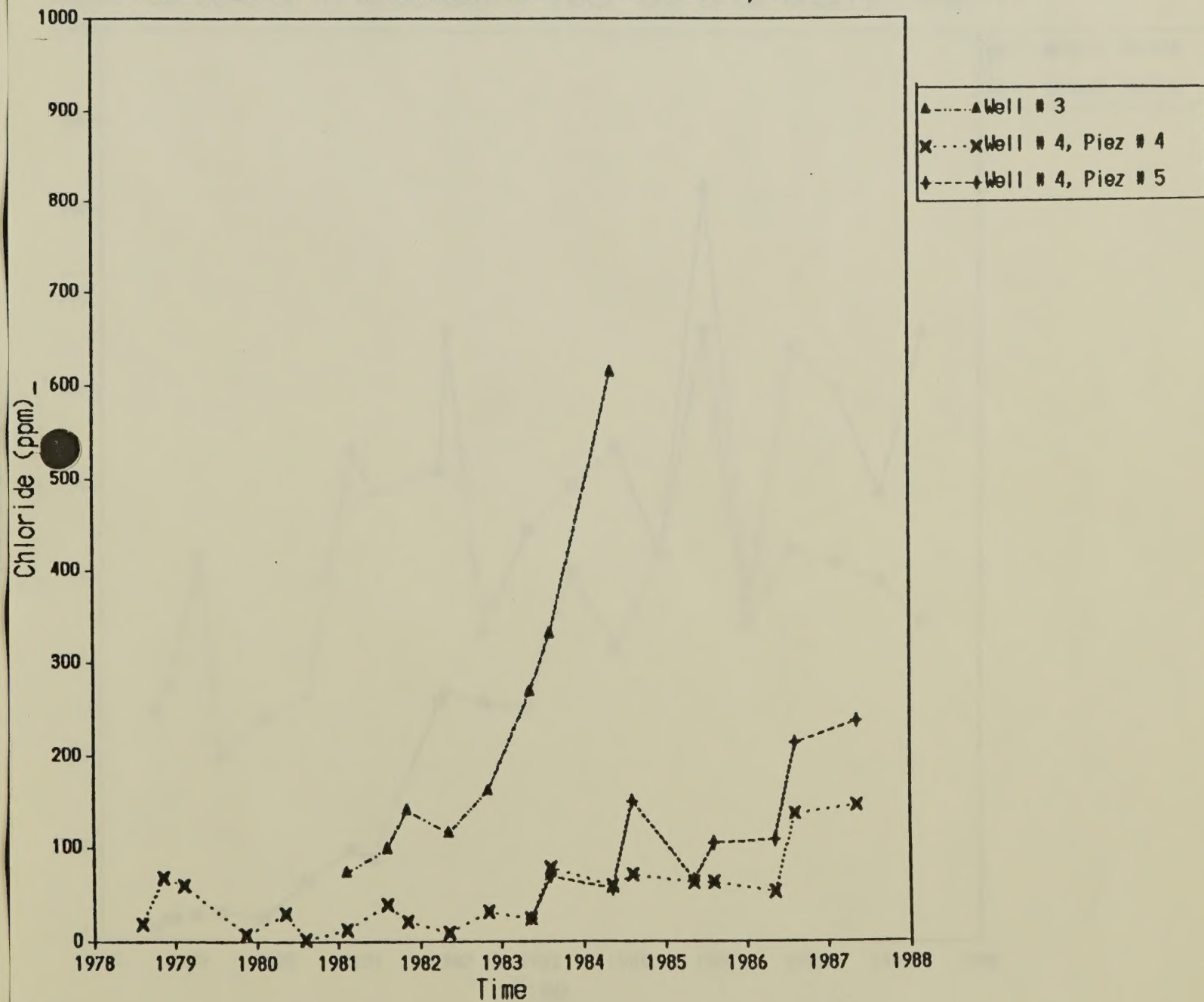
Chloride Levels in Groundwater near the Brow Quarry Landfill



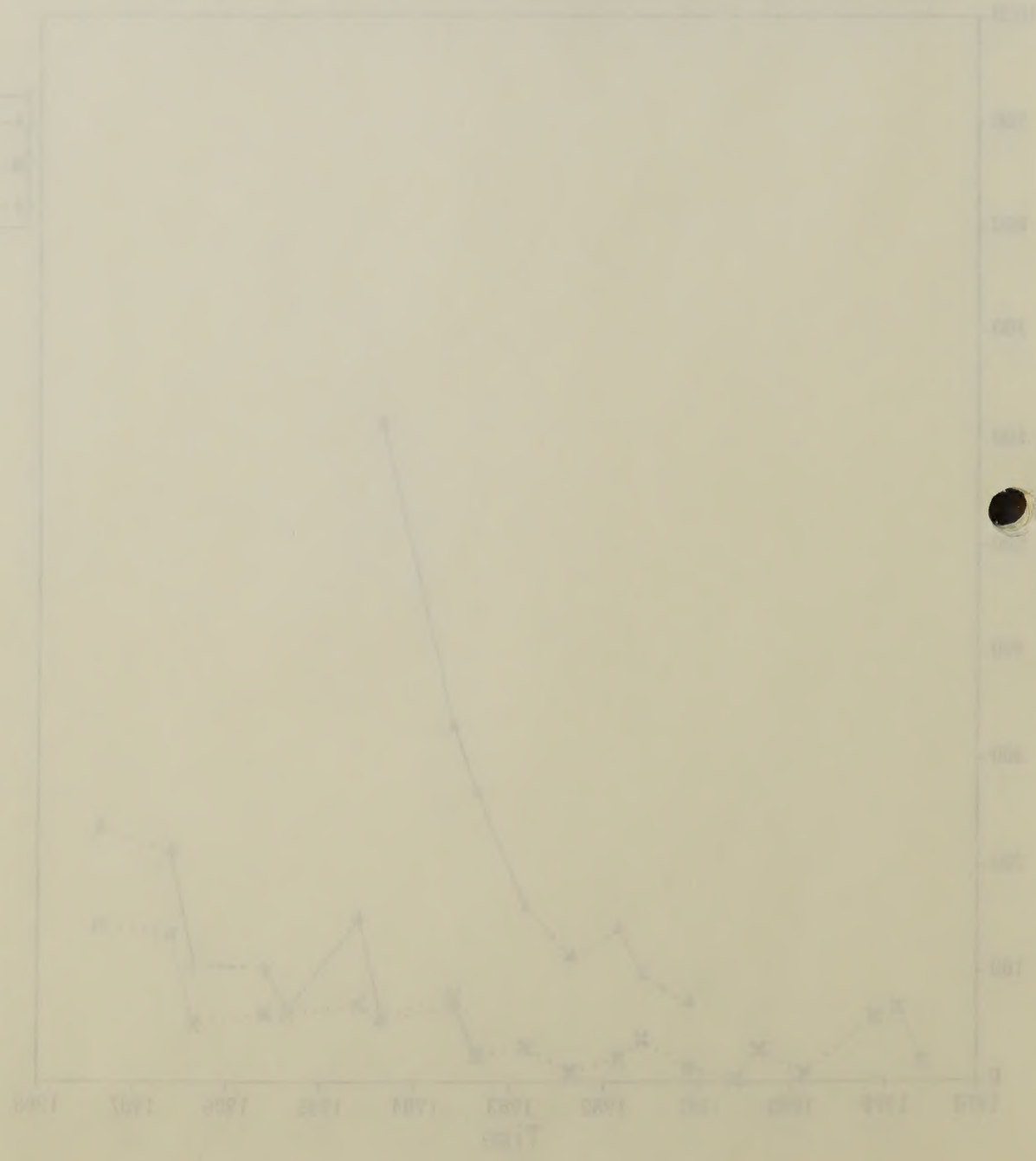
Chloride Levels in Groundwater near the River (mg/L)



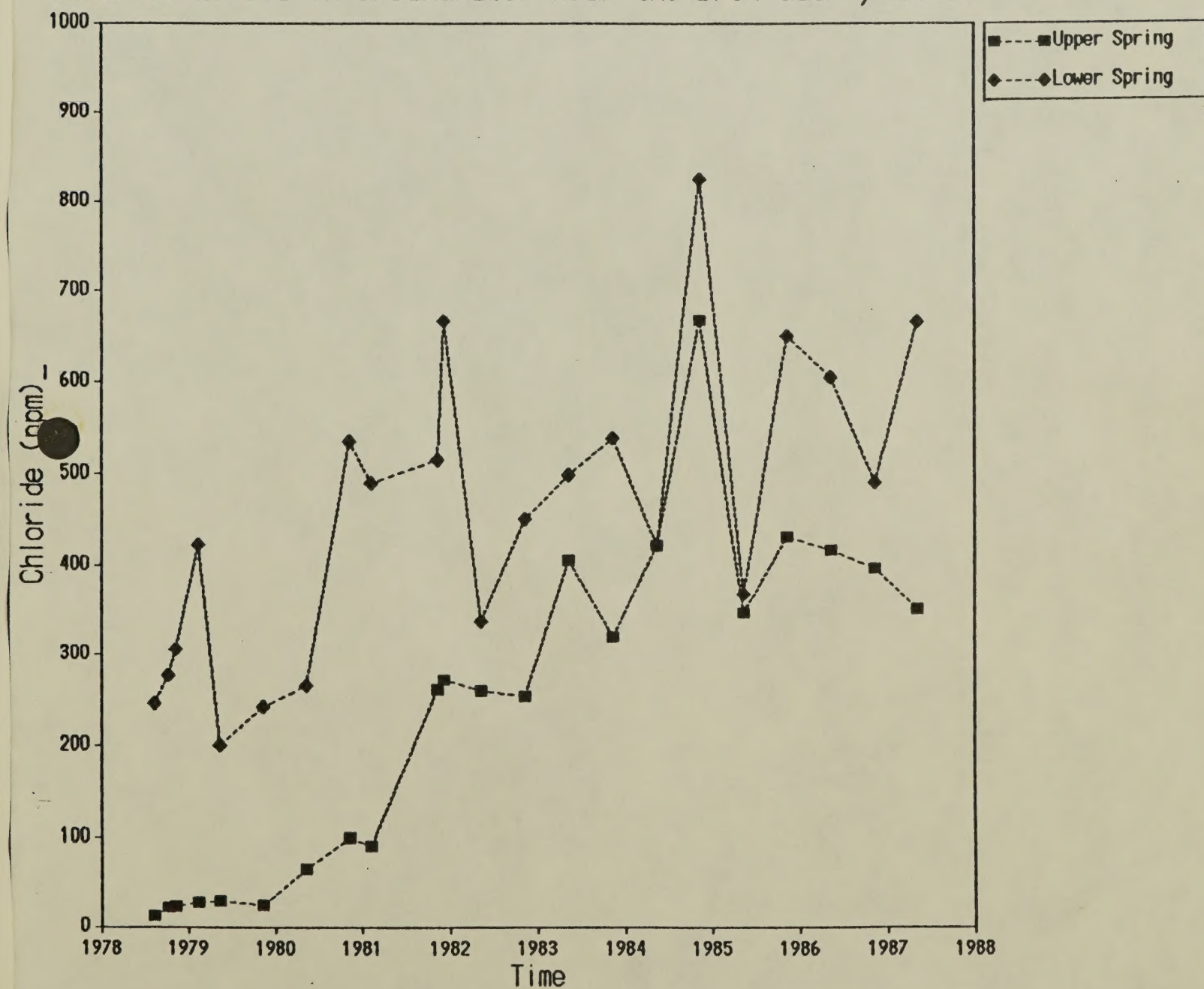
Chloride Levels in Groundwater near the Brow Quarry Landfill



Chlorine Levels in Groundwater near the Brown County Landfill



Chloride Levels in Groundwater near the Brow Quarry Landfill



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